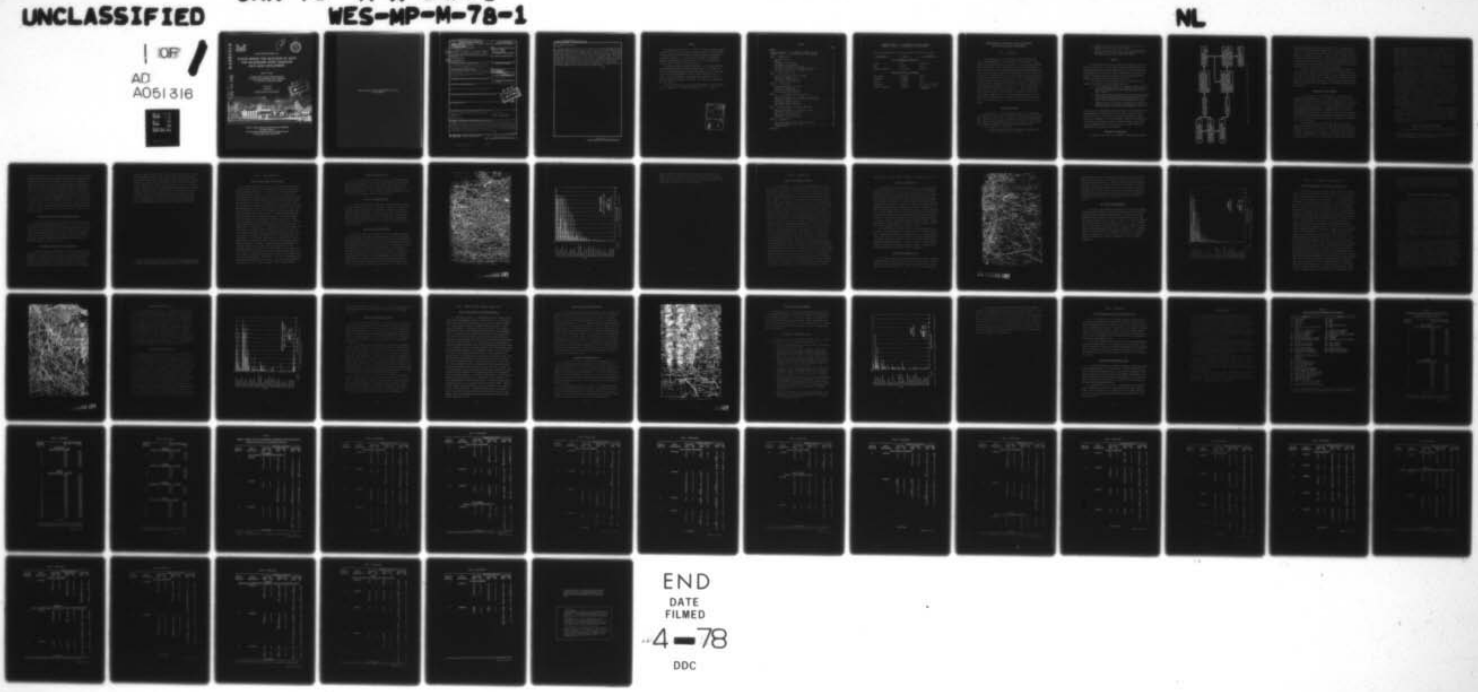
AD-A051 316 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MISS F/G 17/1
STATUS REPORT FOR SELECTION OF SITES FOR BACKGROUND NOISE SIGNA--ETC(U)
JAN 78 M A ZAPPI
UNCLASSIFIED WES-MP-M-78-1 NL

1 OF 1
AD
A051316



END
DATE
FILMED
4-78
DDC

SIFIED

1 OF 1

AD
A051316

1.0	4.5	2.8	2.5
	5.0	3.2	2.2
	5.6	3.6	
1.1	6.3	4.0	2.0
			1.8
1.25	1.4	1.6	

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

MISCELLANEOUS PAPER M-78-1

STATUS REPORT FOR SELECTION OF SITES FOR BACKGROUND NOISE SIGNATURE DATA BASE DEVELOPMENT

by

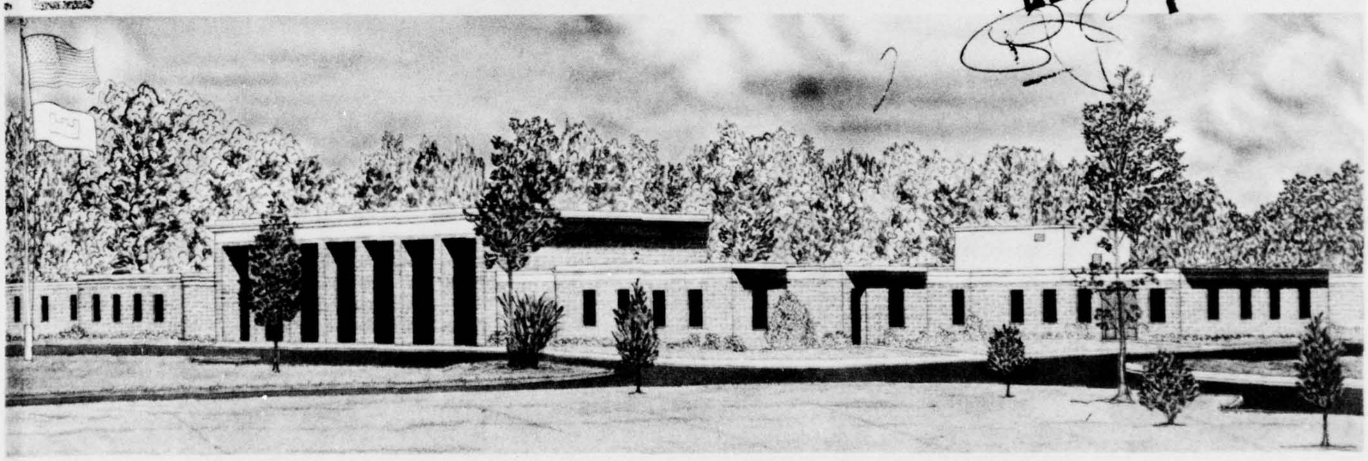
Marcos A. Zappi

Mobility and Environmental Systems Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

January 1978

Final Report

Approved For Public Release; Distribution Unlimited



Prepared for Project Manager, Remotely Monitored Battlefield Surveillance System
U. S. Army Materiel Development and Readiness Command
Fort Monmouth, New Jersey 07703

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (14) WES-MP- Misce~~llaneous Paper~~ M-78-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) (6) STATUS REPORT FOR SELECTION OF SITES FOR BACKGROUND NOISE SIGNATURE DATA BASE DEVELOPMENT,		5. (9) TYPE OF REPORT & PERIOD COVERED Final report,
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Marcos A. Zappi		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Mobility and Environmental Systems Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Project Manager, Remotely Monitored Battlefield Surveillance System, U. S. Army Materiel Development and Readiness Command, Fort Monmouth, New Jersey 07703		12. REPORT DATE (11) Jan[redacted]978
		13. NUMBER OF PAGES 55 (12) 22p.
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Remotely monitored battlefield sensor system
Seismic waves
Sensors
Site selection
Sound waves
Target classification
Vehicle (Signature)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A major objective of the Remotely Monitored Battlefield Sensor System (REMBASS) is to develop seismic or acoustic sensors, or both, that can identify and classify various kinds of targets, such as tracked and wheeled vehicles and men walking, in diverse world environments. Further, the sensors must be able to discriminate between signals emanating from the targets and signals generated by background noise sources present in a given area.

(Continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

038 200 JOB

20. ABSTRACT (Continued).

The purpose of this project was to identify areas in West Germany and the Middle East (Jordan) for which background noise data sources were known or could be estimated, and match the information from those areas to sites in the United States that could be used for REMBASS sensor evaluation or testing. Three study areas were selected in the North German Plain, one in eastern Jordan, three in the Atlantic Coastal Plain of the U. S., and one in southwest Texas. It is concluded that an acceptable degree of similarity in background noise source characteristics can be established between the study areas selected in the North German Plain and those chosen in the Atlantic Coastal Plain. Likewise, an acceptable correlation was made between the background noise sources identified in eastern Jordan and those identified in southwest Texas.

PREFACE

The work reported herein is a portion of a seismic research program conducted by the U. S. Army Engineer Waterways Experiment Station (WES) and sponsored by the Project Manager, Remotely Monitored Battlefield Surveillance System, U. S. Army Materiel Development and Readiness Command, Fort Monmouth, New Jersey, under Project No. 1X764723DL73 entitled "Target Signature Data Base Study."

The work was under the general supervision of the Chief, Mobility and Environmental Systems Laboratory (MESL), Mr. W. G. Shockley, the Chief, Environmental Systems Division (ESD), MESL, Mr. B. O. Benn, and the Chief of the Environmental Research Branch, ESD, MESL, Dr. L. E. Link. Technical supervision and guidance were provided by Mr. J. R. Lundien, Electrical Engineer, ESD, MESL. This report was prepared by Mr. M. A. Zappi.

Director of WES during this work and preparation of the report was COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) AND METRIC (SI) TO U. S. CUSTOMARY UNITS OF MEASUREMENT

Units of measurement used in this report can be converted as follows:

Multiply	By	To Obtain
U. S. Customary to Metric (SI)		
inches	2.54	centimetres
feet	0.3048	metres
degrees (angular)	0.01745329	radians
Metric (SI) to U. S. Customary		
centimetres	0.3937007	inches
decimetres	0.3280839	feet
metres	3.280839	feet
kilometres	0.6213711	miles (U. S. statute)
square kilometres	0.3861021	square miles (U. S. statute)

STATUS REPORT FOR SELECTION OF SITES FOR BACKGROUND NOISE SIGNATURE DATA BASE DEVELOPMENT

PART I: INTRODUCTION

1. The major objective of the Remotely Monitored Battlefield Sensor System (REMBASS) is to develop seismic and/or acoustic sensors that can identify and classify various kinds of targets (such as tracked and wheeled vehicles and men walking) in diverse world environments. Such sensors must be able to discriminate between signals emanating from the targets and signals generated by background noise sources present in a given area. The amount and kinds of background noises are the result of natural conditions or features found in the area (meteorological conditions, drainage systems, vegetative cover, etc.) and of cultural features and level of development (the number and classes of roads, degree of urbanization, agricultural practices, etc.). From a statistical point of view, it would be highly desirable to obtain characteristic background noise mixes in all worldwide environments of significant areal extent. However, such a task is economically impractical, and background noise data obtained at carefully selected sites are extrapolated or interpolated for use at sites of operational interest to the Army.

Objective and Scope

2. The objective of the work reported herein was to study known or estimated noise data sources for areas in West Germany and the Middle East (Jordan), and match this information to sites in the United States that could be used for REMBASS sensor testing. Results of such testing would enhance the REMBASS background noise signature data base.

3. Map studies were conducted to:

   a. Define the spatial relation of potential background noise sources to each other in West Germany.

b. Define the spatial relation of potential background noise sources to each other in eastern Jordan.

c. Select sites in the United States that are considered to have mixes of background noise sources similar to those in the areas studied in West Germany and Jordan.

Approach

4. The procedures used in this study were essentially those presented in Part IV of U. S. Army Engineer Waterways Experiment Station Miscellaneous Paper M-75-10, "Rationale and Plan for Field Data Acquisition Required for the Rational Design and Evaluation of Seismic and Acoustic Classifying Sensors," November 1975. The general approach followed is outlined in the flow diagram in Figure 1.

5. The selection of data collection sites in the United States (Figure 1) was based on the following assumptions:

a. In two regions with similar environmental conditions (soils, relief, meteorology, vegetation, geology, etc.), seismic and acoustic energy will be generated and propagated in a similar manner.

b. Seismic and acoustic energy sources (as defined or inferred from recent good-quality maps and aerial photographs), especially those of natural background noise sources, can be used to deduce similarities of background noise signals.

c. Composite seismic and acoustic signatures are related in a predictable way to the energy generating source, the propagating medium, and the distance from source to sensor.

Because the U. S. Army Mobility Equipment Research and Development Command (MERADCOM) had requested that, for economic reasons, sites be selected as close to Fort Belvoir as possible, the Atlantic Coastal Plain was the primary U. S. area considered. However, the study had to be extended to the Edwards Plateau of southwest Texas because the regional physiographic characteristics of eastern Jordan could not be identified in the Atlantic Coastal Plain.

Strength of the Approach

6. Experience has shown that a number of environmental features

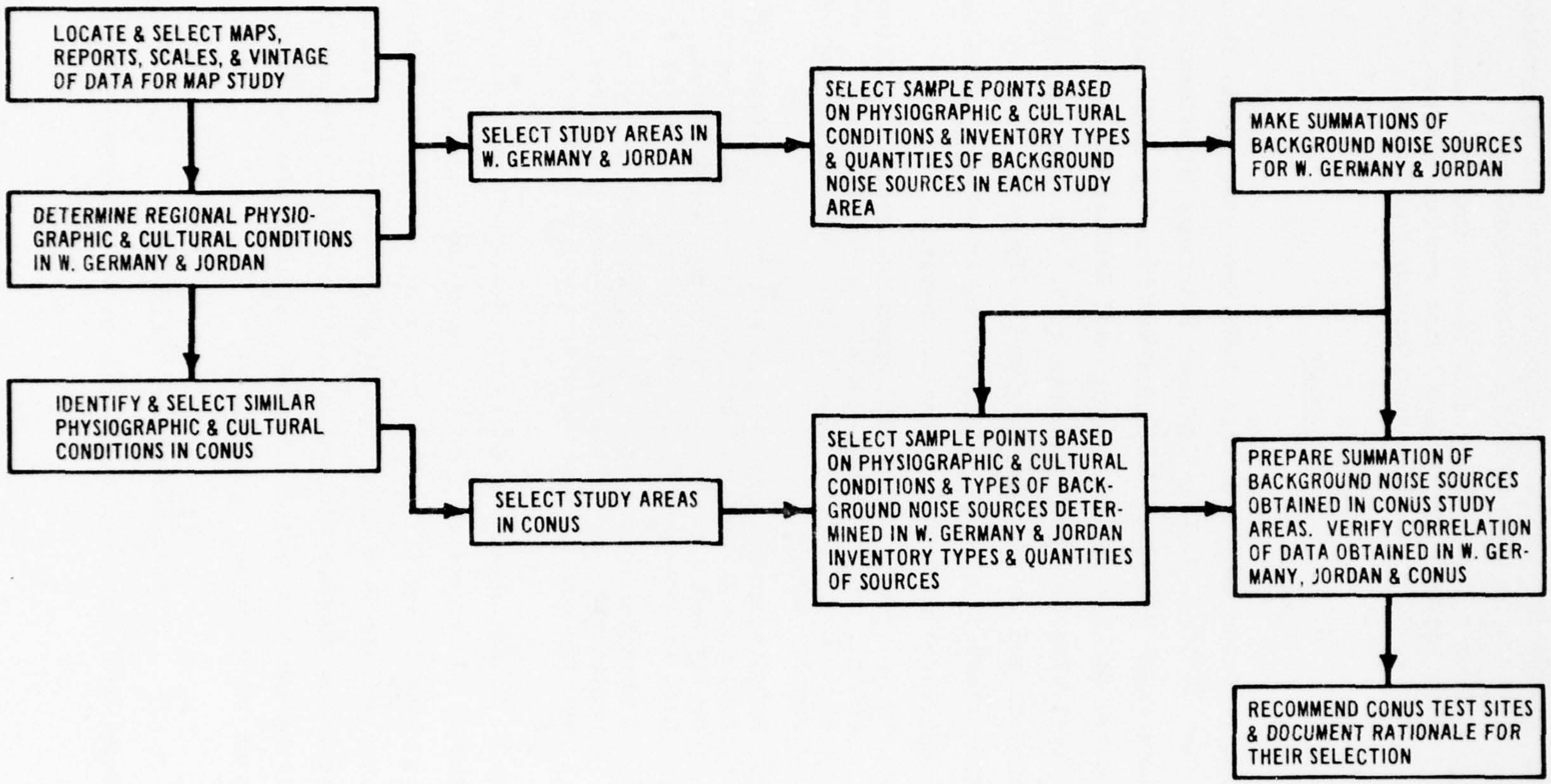


Figure 1. Flow of site selection work for the Background Noise Study

produce background noise signatures characteristic of a given location or terrain. In designing classifying sensors, the approach usually taken is to design the sensor on the basis of target or source signals measured or recorded in the field. However, this is not always possible or feasible in foreign countries. As an alternative approach, it seems prudent to generate a data bank of significant signatures on the basis of signature data, either measured or inferred, obtained from a careful study and analysis of selected locations and features.

7. In most instances, based on known physiographic conditions (i.e. terrain and climate), good correlations can be made between natural features or signature sources found in similar geographic locations or areas. Also, in most cases, acceptable levels of similarity can be established between background noise signatures generated by cultural sources or practices that are indigenous to comparable geographic areas and countries.

Limitations to the Approach

8. It is difficult to establish similarity in background noise signatures from foreign areas, e.g. central Europe, with those from areas in the United States without measured signature data. A map study, such as described herein, can provide only indications that the background noise sources are similar. Differences in cultural practices and development, even between West Germany and the U. S., make the extrapolation and correlation of identified signature sources uncertain. The problem is accentuated when signature sources derived or inferred from a map study of such divergent cultural environments as Jordan and the U. S. are involved.

9. The terms (types) used to identify some of the signature sources were selected on the basis of mapped data and frequently the terms were too broad or all inclusive. This can result in misleading signature source data interpretations or assumptions, particularly in the case of background noise signature data derived or inferred from cultural features. For instance, the types and quantities of sources

inventoried within a given interval (e.g. 0.5 to 1.0 km*) do not always identify exactly the same kind of background noise sources, e.g. a shallow hand-dug well with a bucket and a deep-water well with an electrical pump are both classified as water wells yet the signatures are obviously quite different. It is felt, however, that sufficient similarity can be established between or deduced from most of the cultural features found in generally similar cultural regions to make possible the valid correlation of their signature source data.

10. Differences in the kind and quality of terrain information provided by topographic maps produced by different countries or different sources create a problem in identifying signature sources. Available German topographic maps are quite detailed and provide a considerable amount of terrain data; most types of agricultural areas (e.g. pastures and vineyards) are usually identified. In contrast, U. S. topographic maps often do not show such detailed information and, therefore, some signature sources cannot be compared directly. Further, the use of outdated maps and photographs, frequently the only ones available, cannot be expected to provide current information on cultural features or developments; this affects the identification of background noise signature sources. For these reasons, some discrepancies between map-derived signature data and field-collected data should be expected, particularly where cultural features are involved.

11. To attempt to identify and list all possible sources of background noise on a worldwide basis would be impractical, especially when diverse physiographic conditions and levels of cultural development are considered. The list of terms (types) identified in Table 1 has been very useful to date; it may have to be changed or expanded as additional worldwide conditions are encountered.

Constraints Imposed on This Study

12. The lack of field data, especially of acoustic signatures,

---

* A table of factors for converting metric (SI) units of measurement to U. S. customary units is presented on page 3.

was one of the main constraints imposed on this study. Time and funding limitations were also very important; this precluded the possibility of obtaining current terrain information, such as aerial photographs, in the areas of interest. A search of available sources of information, Defense Intelligence Agency (DIA) and Defense Mapping Agency (DMA) revealed that the maps or aerial photographs available for Jordan were more than 10 years old. Likewise, in the U. S. and West Germany, there is a dire need for recent aerial photographs and maps for terrain analysis studies. The request by MERADCOM that sites be selected as close as possible to Fort Belvoir (paragraph 5) was also, to a lesser extent, a limiting factor in the selection of study areas. However the adverse effects of these constraining factors were minimized because of experience gained from worldwide terrain studies and analyses previously conducted by the WES.

Rationale for Selection of Foreign Study Areas

13. The foreign study areas were selected primarily on the basis of known, regional physiographic characteristics of each country, and on the basis of cultural practices and conditions determined from intelligence data (unclassified and classified) available and field information and experience acquired by WES personnel in diverse geographical areas (e.g. West Germany, Middle East) during various field studies. These known regional conditions greatly reduced the time and effort required for selection of the study areas.

Rationale for Selection of Source Material

14. Once the regional determination of the study areas was made, WES reports, files and other data sources (e.g. DIA, DMA, United States Department of Agriculture, and United States Geological Survey) were contacted to determine the types and scales of maps available, the availability and adequacy of photographic coverage, and the vintage (dates) of reports, maps, and other information that could be readily

obtained. Based on this search, it was determined that the use of available topographic maps was the most feasible way to develop the source data input required for the study within the prescribed funding and time limitations. Series M745* (1:50,000) maps were selected for the study in West Germany, Series K737* (1:50,000) maps were selected for eastern Jordan, and 7.5-min series** (1:24,000) maps were selected for the United States. Although 15-min series** (1:62,500) topographic maps, a more compatible scale, were available for most areas of interest in the U. S., they were not selected because most of them were dated in the 1950's, thus making their information too obsolete for practical use in such rapidly changing areas as the Atlantic Coastal Plain region.

---

* Maps in this series may be obtained from the Defense Mapping Agency.
** Maps in this series may be obtained from the U. S. Geological Survey.

PART II: WEST GERMANY SITES

General Physiography of West Germany

15. The country may be divided into four main physiographic units: the North German Plain, the Central Highlands and Plains, the Southern Plain, and the High Mountains. An inspection of selected topographic maps indicated that, except for a few local cultural features (e.g. recreational areas or parks), most of the cultural and natural characteristics found in the Central Highlands and Plains and the Southern Plain would be found in the North German Plain and it was, therefore, chosen for the map study. Because of the importance of mechanized warfare, the High Mountains unit was not considered to be significant for this study. The North German Plain is a flat to rolling, broad lowland, which comprises about one third of West Germany. It extends southward from the North and Baltic seas to the northern fringes of the Central Highlands and Plains unit, where it grades into a complex of rolling to rough hills, low mountains, and interspersed plains of varying sizes. Coarse-grained soils, mainly poorly graded sands, predominate in the North German Plain. In flat areas, e.g. coastal flats, the poorly graded sand is overlain by a surficial layer of either silty sand or organic silt, which ranges in thickness from a few centimetres to about 0.50 m. Fine-grained soils are widely distributed but are less extensive; they consist mostly of low plasticity clays and silts. Highly organic soils, chiefly peat, are generally found in flat areas and depressions and are the least extensive. Bedrock is largely covered by unconsolidated deposits more than 6 m deep. Major river valleys generally trend northwest-southeast and north-south. Most streams are wide, deep, and slow flowing. Narrow, low bogs frequently flank the drainageways. Peat bogs, marshes, and drainage ditches are most common in the coastal areas of the north and northwest. Differences in the range of temperature and the amount of precipitation are not great. The mean annual temperature is estimated to be 9°C. Annual average rainfall is about 800 mm.

Selection of Study Areas

16. Based on the map study reported in Part IV, WES Miscellaneous Paper M-75-10 (paragraph 4), and on the physiographic and cultural conditions found to prevail in West Germany, three study areas were selected in the North German Plain: the Bad Oldesloe, the Wietze, and the Duren areas (Figure 2). The 1:50,000 topographic quadrangle of each area defines the geographic limits of each study area.

Selection of Sampling Points

17. Sampling points in each study area were selected on the basis of observed cultural development and general topographic trends, so as to obtain a good representation of the various natural and cultural features found in each area. Ten sampling points were selected in the Bad Oldesloe area (Sheet L2128), 10 in the Wietze area (Sheet L3324), and 6 in the Duren area (Sheet L5104). The Universal Transverse Mercator (UTM) 1000-m grid coordinates of each sampling point selected are given in Table 2.

Data Extraction and Summation

18. Each sampling point was plotted on the topographic quadrangle of the study area. The sampling points were used as reference or center points to inventory the various areas being mapped within the quadrangle. The mapping procedures described in Part IV of the WES paper cited above were then used to inventory the types and number of occurrences of potential background noise sources found within each of three specified intervals--0.0-0.5, 0.5-1.0, and 1.0-2.0 km. Source data recorded and compiled for each sampling point are given in Table 3 by study areas. A summation of all noise source data inventoried in the three study areas mapped in the North German Plain is graphically presented in Figure 3. Source data obtained in the Fulda area study (Sheet L5524), previously reported in the WES paper, were analyzed to establish that

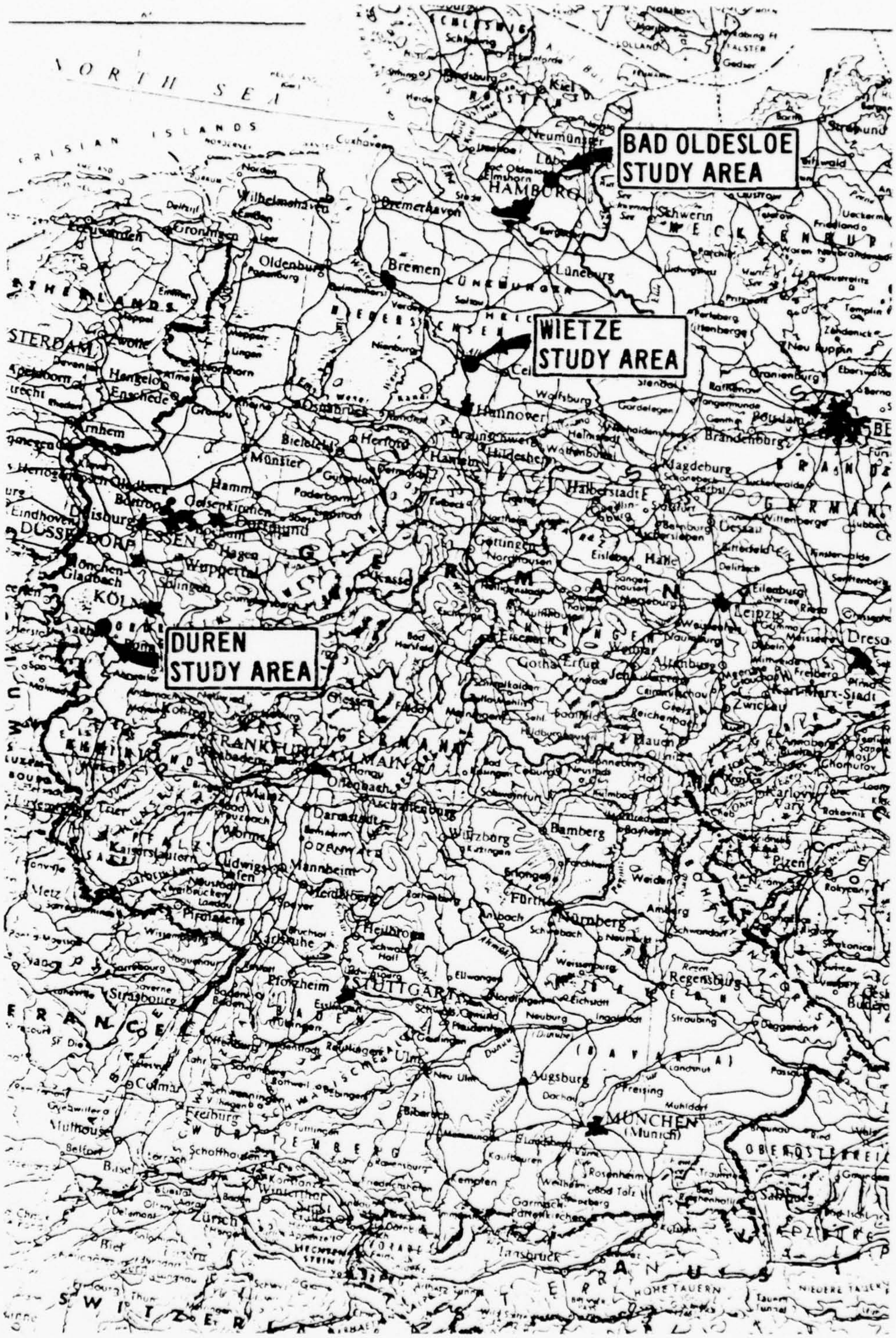


Figure 2. Study areas in West Germany

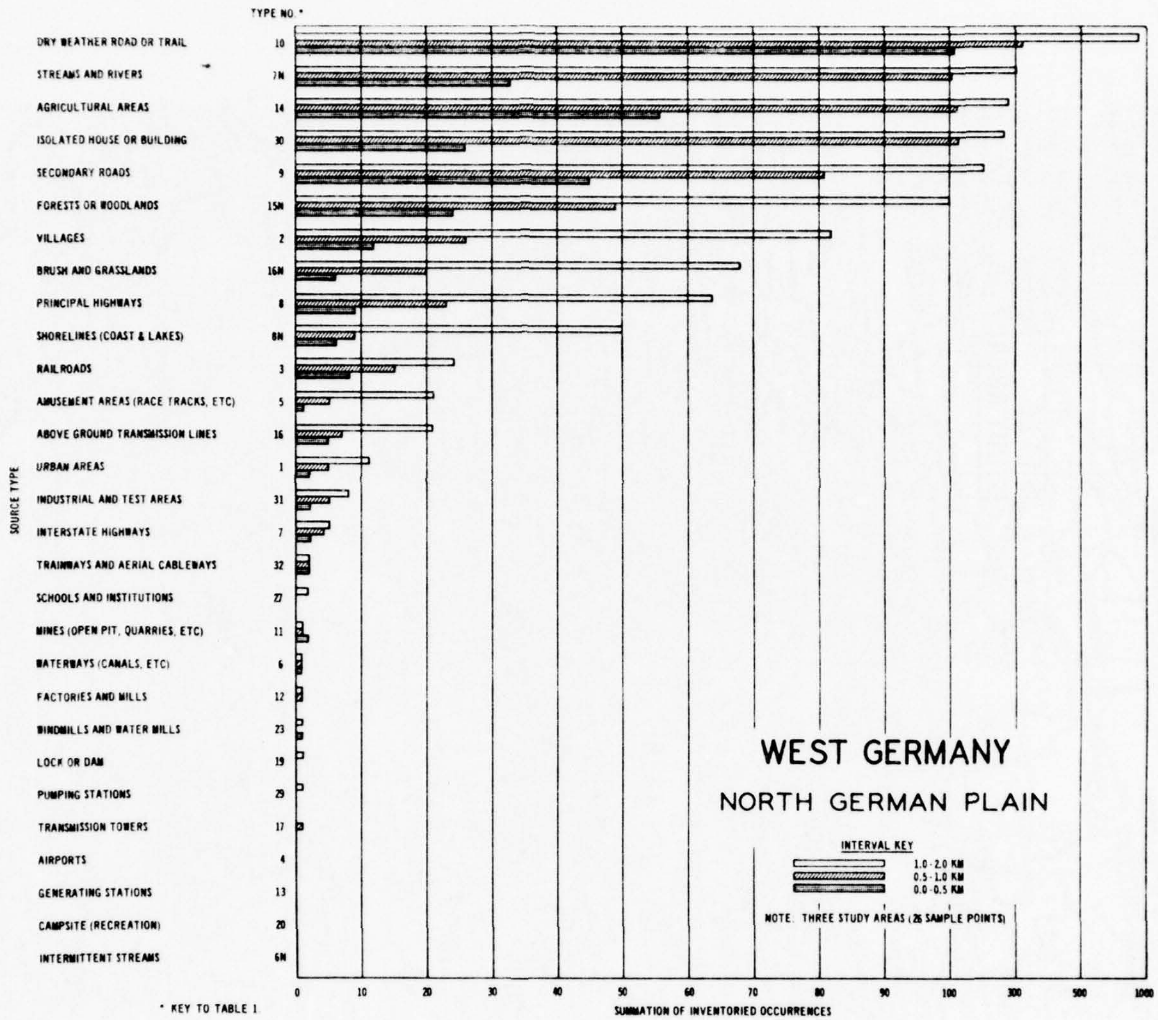


Figure 3. Noise sources in descending order of occurrence for the 1.0- to 2.0-km interval

they were similar to and correlated with the data obtained in this study. Thus, it was determined that the background noise source data obtained in the three West German areas used in this map study were in accord with the data obtained in the Fulda area.

PART III: JORDAN SITES

General Physiography of Jordan

19. Most of Jordan is a flat to rolling plain, part of the vast desert which covers much of Syria, Iraq, and Saudi Arabia. The remainder consists of two belts of hills and mountains separated by the long, relatively narrow depression of the Jordan River (between Lake Tiberias and the Dead Sea) and the Wadi Al Arabah (between the Dead Sea and the Gulf of Aqaba). On the basis of topography, Jordan is usually divided into two major physiographic units: the Eastern Plain and the Western Hills and Mountains. The Eastern Plain is elevated, a plateau that lies mostly between 500 and 1000 m above sea level and covers the eastern two thirds of Jordan. North of 30°N latitude, there are widely spaced, sharp-crested hills that rise up to 100 m above the plain. More closely spaced buttes and mesas, up to 150 m above the plain, occur south of 30°N. Most of the plain is underlain by carbonate rocks (chiefly limestone); a broad belt of basalt extends from the Jabal Ad Druz in Syria southward across the panhandle into Saudi Arabia. Sandstone predominates in a broad band that extends west from Jabal At Tubayq along the southern border with Saudi Arabia. Fine-grained soils (mainly silt, silty clay and gravelly clay) are found over most of the region. Clay of high plasticity occurs in scattered local areas. Poorly graded gravel and silty or clayey gravel mantle the belt of basaltic lava; poorly graded sand and gravel develop on the sandstone band along the southern border. The surface of the plain is cut by numerous intermittent streams (wadies), which drain mainly towards the Azraq Shishan and Al Jafr depressions in eastern Jordan and Wadi As Sirhan in Saudi Arabia. The wadies carry water only for brief periods after rains that are most likely to occur from early November through March. A few spring-fed pools and lakes are in the north-central part of the plain. There are no perennial streams in the Eastern Plain. The average annual rainfall is highest in the western region and decreases to the east and south. In the Mafraq area (discussed below), the average annual rainfall is

about 200 mm. The mean annual temperature is estimated to be 17°C.

Selection of Study Area

20. The Mafraq area (Figure 4) was selected as the Jordan study area primarily because it is close to the Syrian border. The Mafraq quadrangle (Sheet 3254 IV) defines the geographic limits of the study area which covers an estimated 640 km^2. Most of the area is in the Eastern Plain; its western margin is transitional between the Eastern Plain and the Western Hills. The town of Mafraq, located in the east-central part of the area, is about 15 km south of the Syrian border and about 50 km north-northeast of Amman, the capital of Jordan. It is a major transportation center in the northern sector of the Eastern Plain. It is a major highway center in eastern Jordan, and is on the railroad, the only one in Jordan, that runs from Damascus in Syria south to Ras en Naqb in Jordan, where it connects with the paved highway that goes to the Port of Aqaba. The Iranian Petroleum Company pipeline traverses the study area from northwest to southeast through the town of Mafraq. There are 30 villages scattered throughout the area.

21. The Mafraq area is mostly rural and agricultural and is considered to be representative only of that section of the Eastern Plain that is underlain by carbonate (limestone) rocks. It is not representative of that section of the plain covered by volcanic (basaltic) rocks, a condition found over large areas of the Eastern Plain and adjoining parts of Syria and Saudi Arabia. There are reasons to believe that the "basalts" of eastern Jordan _may_ be quite vesicular, a condition that could seriously affect anticipated seismic signatures.

Selection of Sampling Points

22. Sixteen sampling points were selected on the basis of observed cultural features and the topographic diversity of the area. The topographic map shows a relatively high density of population here as compared to the more arid areas to the east. There is also an unusually

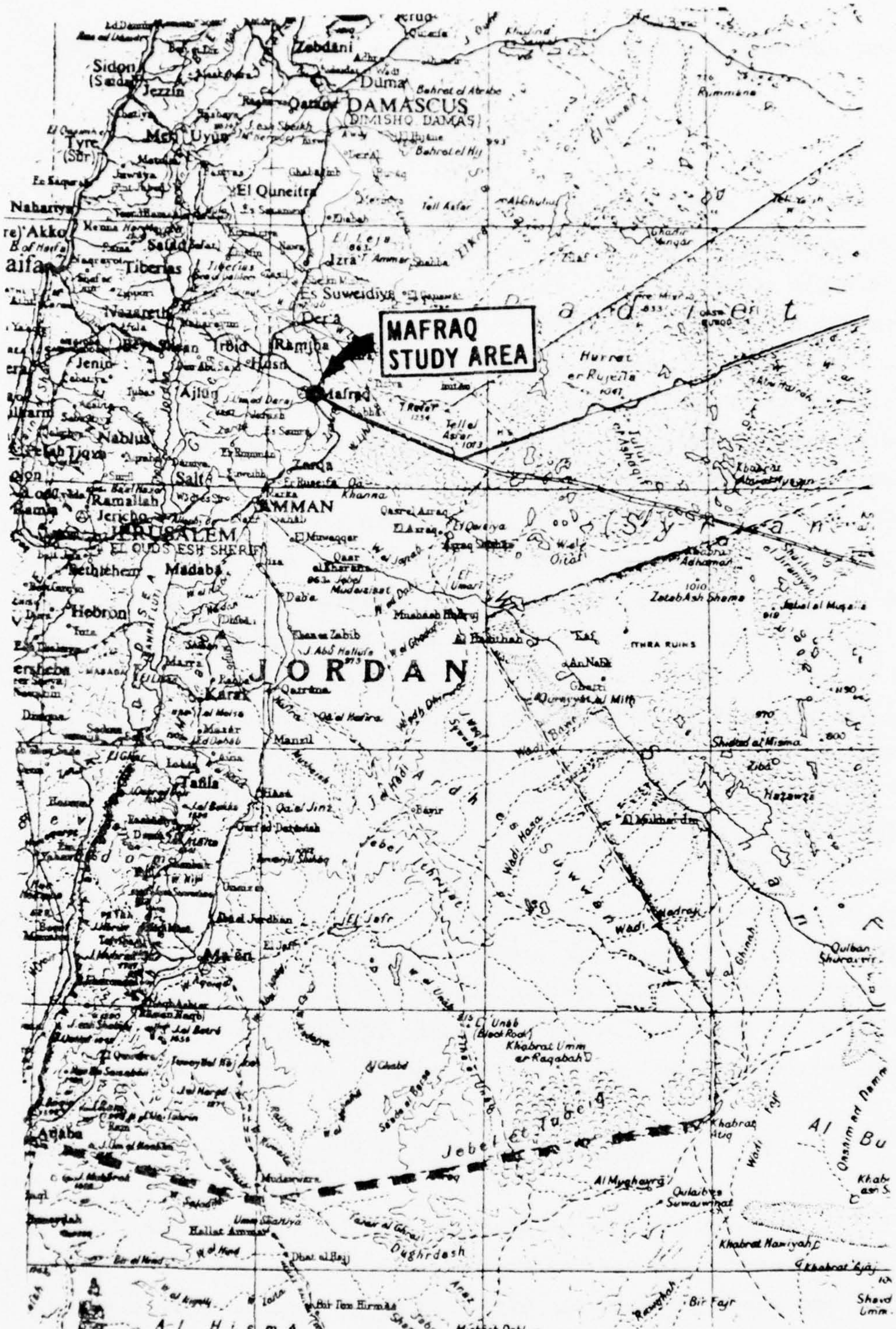


Figure 4. Study area in Jordan

high number of water wells, mostly shallow hand-dug wells, and cisterns. They are usually found in the immediate vicinity of villages and isolated farm houses and buildings. The town of Mafraq is a major military and desert patrol post. Because of the high concentration of cultural activities, special attention was given to the selection of sufficient sampling points to make certain that a valid representative sample was obtained of the potential background noise sources in this study area. The UTM 1000-m grid coordinates of each sampling point are given in Table 2.

Data Extraction and Summation

23. The inventory and mapping procedures used, as well as the data extraction methods followed, were those already described for the three study areas in West Germany (paragraph 18). The compilation of data obtained in the inventory of potential background noise sources from each sampling point is given in Table 3. Figure 5 is a graphic presentation of the occurrence of noise sources mapped in this area. The high count of water wells and dry weather roads or trails reflects the physiographic and cultural environment of this geographic region. Likewise, because the town of Mafraq is an important military post in the Eastern Plain, the occurrence of certain military facilities, e.g. training areas and firing ranges, should be considered very local cultural conditions.

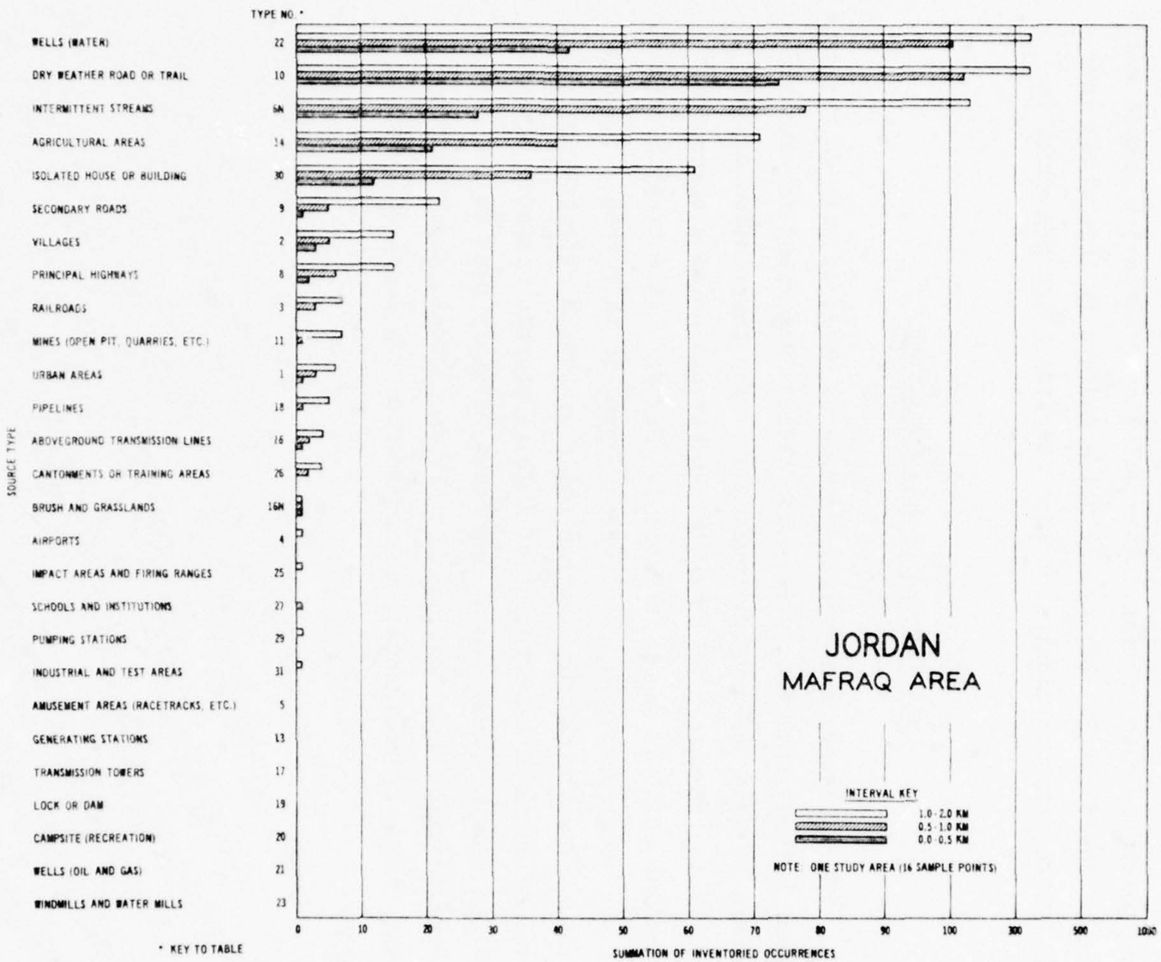


Figure 5. Noise sources in descending order of occurrence for the 1.0- to 2.0-km interval

PART IV: U. S. ATLANTIC COASTAL PLAIN SITES

General Physiography of the Atlantic Coastal Plain

24. This plain is part of the large coastal plain of the United States that extends for 3000 km along the Atlantic and Gulf coasts and ranges in width from 160 to 500 km. The Atlantic Coastal Plain starts at Long Island and widens rapidly southward so as to include much of New Jersey, Delaware, Maryland, and Virginia. It continues to the south and includes large sections of the Carolinas, Georgia, and Florida, where it merges with the eastern Gulf Coastal Plain. In the region covered by this study, i.e. the Atlantic Coastal Plain in Maryland and Virginia (see MERADCOM request in paragraph 5), the plain is underlain primarily by Cretaceous and Tertiary sedimentary strata that are generally porous and retard erosion by absorbing most of the surface water runoff. The inner limit of the plain, i.e. its western margin, is marked by the Fall Line, a transitional zone between the Atlantic Coastal Plain and the Piedmont Province. This zone marks the break between the mainly crystalline rocks of the Piedmont and the sedimentary rocks of the Coastal Plain. It is a zone of rapid change in stream gradients, characterized by waterfalls and rapids, which act as an effective barrier to advancing tidal surges in coastal streams. Chesapeake Bay divides the Maryland coastal plain into two main sections: all of the plain east of the bay and south of the Elk River is known as the eastern shore; the western shore, or "Maryland Main," extends west from the bay to the Fall Line. The western shore is more undulating and higher than the eastern shore. Soils of the upper eastern shore are primarily loams; the lower area is characterized by stiff clay soils. Sandy and loamy soils predominate in the western shore, except along the lower edge of the Fall Line where a belt of clay soils is found. The soils of the Virginia coastal plain developed mainly on sedimentary formations and are mostly sandy. All main rivers, e.g. the Choptank, Patuxent, Potomac, York, and James, drain into Chesapeake Bay. Most streams are sluggish; many have estuaries and are affected by tidal

action. The Atlantic Ocean and Chesapeake Bay strongly influence the climate, which is mild and generally uniform throughout this coastal region. The mean yearly temperature at Fort George G. Meade (Laurel 7.5-min series quadrangle) is 12°C. The average yearly precipitation is 1000 mm.

Selection of Study Areas in Maryland and Virginia

25. The main objective in the selection of these study areas was to duplicate, as closely as possible, the probable sources of background noises and the potential mixes of background signatures established for the areas studied in West Germany. A comparison of the regional physiographic characteristics (i.e. terrain and climate) found in the North German Plain of West Germany and in the Atlantic Coastal Plain of Maryland and Virginia indicates that, from a physiographic point of view, the two regions are very similar. Therefore, it is felt that an acceptable correlation can be made between the study areas mapped in West Germany and those selected in Maryland and Virginia. On the basis of the cultural features mapped in West Germany and the level of development, the selection of these U. S. areas represents a practical compromise based primarily on inferred map source data and field experience acquired by WES personnel in previous field studies conducted in West Germany.

26. Three study areas were selected in the Atlantic Coastal Plain (Figure 6), two in Maryland (the Laurel 7.5-min series quadrangle and the Savage 7.5-min series quadrangle) and one in Virginia (the Occoquan 7.5-min series quadrangle). The geographic boundaries of each quadrangle define the limits of each study area. The selection of each area was strongly influenced by the availability of recent topographic maps in this rapidly changing cultural region. Of those selected, the Laurel quadrangle was photorevised in 1971, the Savage in 1974, and the Occoquan in 1971. Other more desirable study areas were considered; however, the obsolescence of the aerial photos and maps available for them precluded their selection.

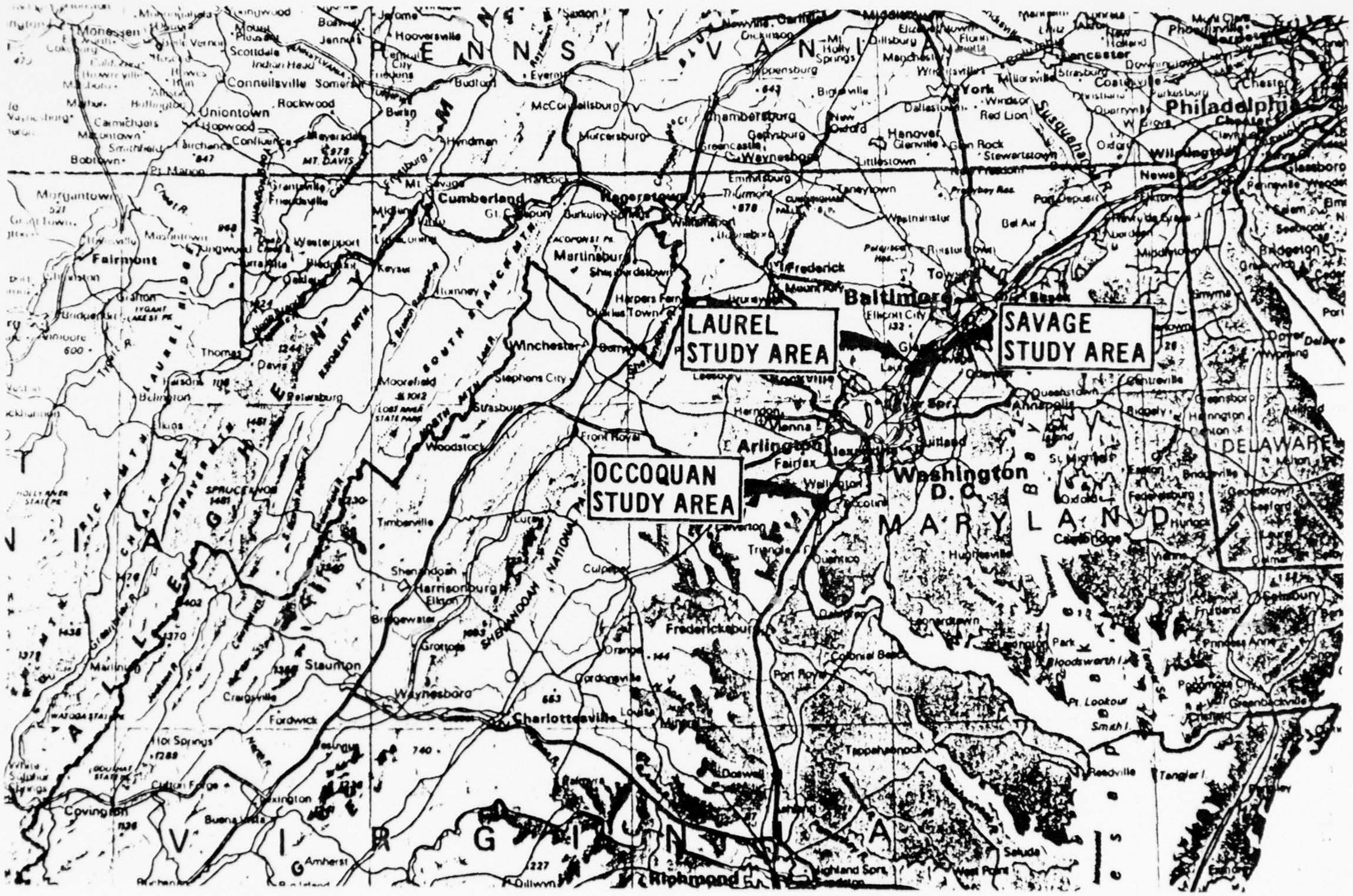


Figure 6. Study areas in U. S. Atlantic Coastal Plain

Selection of Sampling Points

27. The selection and location of each sampling point were controlled primarily by the intended purpose of duplicating, as closely as possible, the natural and cultural features mapped in the West Germany areas. To minimize the field data collection effort, special emphasis was given to the selection of the least number of sampling points required to accomplish the intended objective. Based on the types and occurrences of natural and cultural features found in West Germany, and on the inferred mixes of background noise signatures, four sampling points were selected in the Laurel Quadrangle, three in the Savage, and three in the Occoquan. The UTM 1000-m grid coordinates of these sites are given in Table 2. Field sites actually occupied for the acquisition of background noise signature data should have a good soil or sediment cover, a condition generally found in the North German Plain.

Data Extraction and Summation

28. Mapping procedures followed to determine the types of background noise sources and the number of their occurrences in each area were those previously described for the West Germany study areas (paragraph 18). The compilation of source data obtained at each sampling point is given in Table 3. These data are summarized in Figure 7. When the data presented in Figure 7 are compared to the summation of the data obtained in the three West German areas (Figure 3), several important facts are observed. The average yearly precipitation in the North German Plain is estimated at 800 mm; the average annual precipitation in the Laurel area (Fort George G. Meade) is 1000 mm. Twenty-six sampling points were used in the North German Plain and only 10 in the Atlantic Coast areas. No intermittent streams were inventoried in the West German areas, but a substantial number of these streams were found in the U. S. areas. This anomalous condition seems to indicate that the impact of man in these two regions has been quite significant. The high count of brush and grassland areas obtained in West Germany reflects

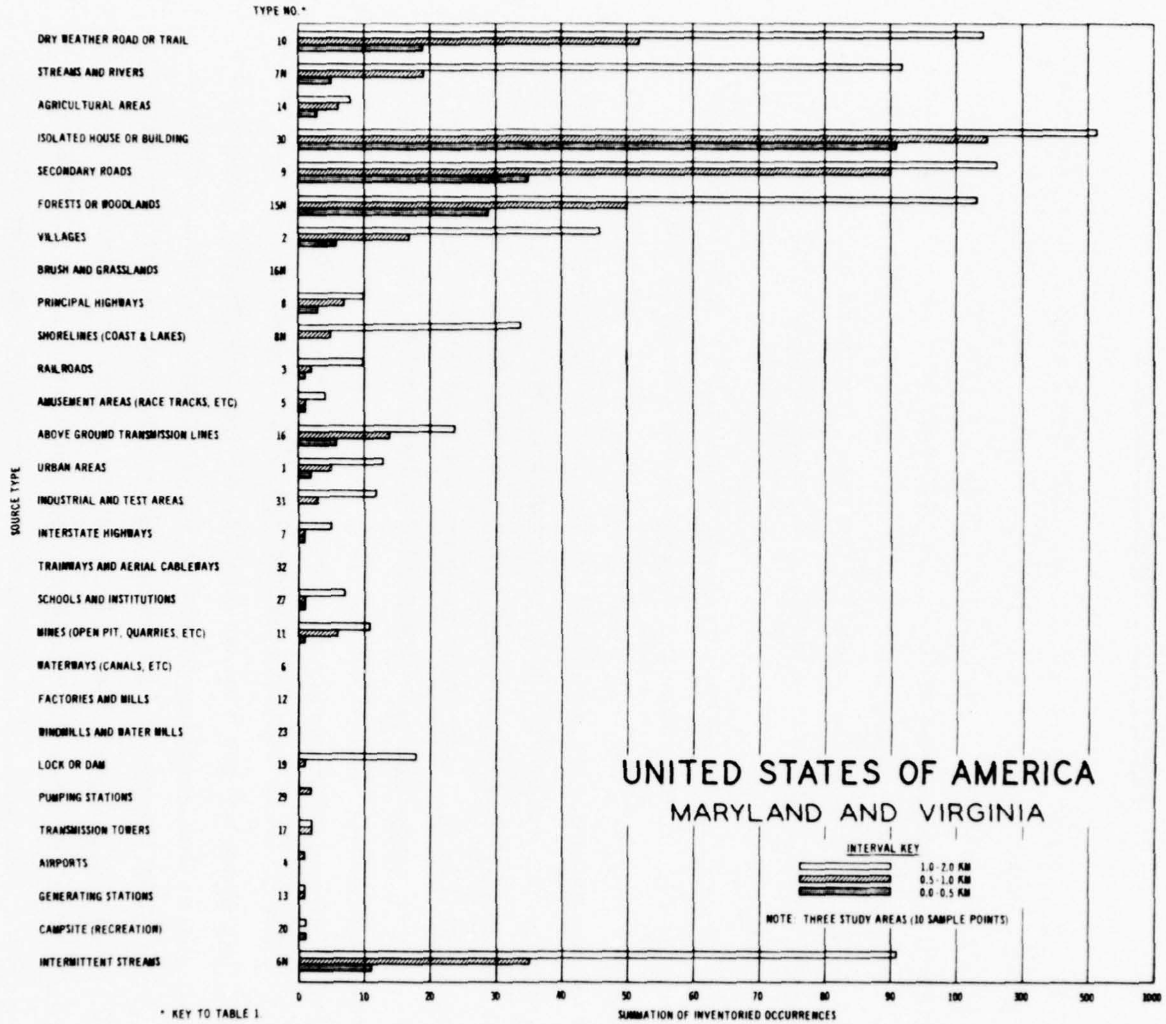


Figure 7. Noise source occurrences corresponding to those of West Germany (Figure 3)

the numerous occurrences of heaths or moors in that geographic region, a relict physiographic condition commonly associated with Quaternary glaciation.

Selection of Primary Test Sites

29. For sensor data acquisition, the Laurel area is the most desirable of the three areas selected in the Atlantic Coastal Plain. Here, the sedimentary strata of the coastal plain are relatively unaffected by metamorphic and igneous rocks. The Occoquan area is the least desirable; the occurrence of exposed metamorphic rocks (granite gneiss and slate) in close association with the Patuxent formation of the Coastal Plain may strongly affect the seismic signatures in several sections of this area.

30. An analysis of the background noise source data inventoried in West Germany and the Atlantic Coastal Plain (Table 3) indicates that most of the sources found in the North German Plain and in the Savage and Occoquan quadrangles are found in the Laurel Quadrangle. The main exception is the relatively high occurrence of brush and grassland areas (Type 16N) found in West Germany, which were not found in the Atlantic Coastal Plain areas. For these reasons, the four sample sites selected in the Laurel quadrangle are designated primary sites for the field data collection program. The sites selected in the Savage and Occoquan quadrangles were chosen primarily as alternative sites, mainly for the acquisition of acoustic or cultural background noise signatures.

31. Because of the vintage (dates) of the topographic quadrangles used to select the sampling points in Maryland and Virginia, all sites should be field checked to determine their current use and availability prior to the initiation of the field data collection program. Final site selection for signature data collection should be in locations which have a deep soil or sediment cover, preferably greater than 6 m, to avoid possible complications from exposed or shallow bedrock.

PART V: EDWARDS PLATEAU, SOUTHWEST TEXAS, SITES

General Physiography of the Edwards Plateau

32. The Edwards Plateau is a physiographic unit or section of the Great Plains physiographic province of the interior U. S. The Edwards Plateau is a limestone tableland that covers about one eight of Texas; it is underlain by the nearly horizontal Edwards limestone, a Lower Cretaceous sequence of limestone, dolomite, and chert. The plateau is separated from the Stockton Plateau, considered by most physiographers to be a continuation of the Edwards Plateau, by the deep canyon of the Pecos River. The plateau slopes gently to the east and south and is separated from the western Gulf Coastal Plain by the Balcones Escarpment. West of the 100th meridian, i.e. in the Ozona area, the landscape is a monotonous grass-covered plain much like the Llano Estacado to the north. In the study area, the soils consist primarily of shallow gravelly loams, loams, and clays developed on the limestone surface. Deep clay loams are found in the valleys and alluvial plains. Main drainage of the Edwards Plateau is provided by the Pecos River, which flows south to the Rio Grande, and the Colorado River which flows to the Gulf of Mexico. There are no perennial streams in the Ozona study area. Surface drainage is by intermittent streams or "draws" which flow only after rains. The main one, Johnson Draw, traverses the area from north to south. A dam across Gurley Draw, a tributary of Johnson Draw, provides for flood protection during infrequent rain storms and confines an intermittent reservoir during wet years. A few shallow depressions or "sinks" retain water a short time after rain. The Ozona area is well known for its high concentration of sheep and Angora goats. Natural gas and oil play an important role in the economy of Ozona and Crockett County. Average annual rainfall ranges from 450 mm in the eastern part of the county to 300 mm in the western part. Extended droughts occur on an average of one year out of five, when rainfall is less than three-fourths of the normal. The average yearly precipitation at Ozona is 450 mm; the mean yearly temperature is 18°C.

Selection of the Ozona Study Area

33. This area was chosen mainly on the basis of its regional physiographic similarity with the Mafraq area of eastern Jordan. The Ozona area is in the east-central section of Crockett County in southwest Texas. Ozona, an unincorporated community, serves as the county seat for Crockett County; it is on U. S. Highway 290, midway between Houston and El Paso, at an elevation of about 700 m. Crockett County is in the western section of the Edwards Plateau. The study area (Figure 8) is defined by the geographic boundaries of the Ozona (1:24,000) quadrangle. From a cultural development aspect, it is considered an acceptable compromise in the United States, where the influence of the rural Mexican culture may provide some similarity to the cultural features and practices found in the Mafraq area. It is doubtful that a better correlative area can be found, except perhaps in the Presidio Plateau or the Marfa Plain of southwest Texas, which may provide a more valid correlation of the "basalt" areas of eastern Jordan (paragraph 21). These areas were not considered herein.

Selection of Sampling Points

34. It will be difficult to duplicate or approximate in the U. S. some of the background noise signatures found in the Mafraq area. It is anticipated that, because of the general physiographic (terrain and climate) characteristics of this area, most of the natural features found in the Mafraq area will be found here. It is also expected that some of the cultural features and practices, e.g. rural agricultural activities and methods, in the Ozona area will generate background noise signatures reasonably similar to those inferred from the map study of the Mafraq area.

35. Six sampling points were selected in this area; their UTM 1000-m grid coordinates are given in Table 2. The selection and location of these sampling points were controlled mainly by the need to duplicate, as much as possible, the background noise sources and signature mixes found, or inferred to exist, in the Mafraq area.

Figure 8. Study area in U. S. Edwards Plateau

Data Extraction and Summation

36. Background signature data were mapped and compiled according to the methods and procedures previously described for the study areas in West Germany (paragraph 18). Data on the types of potential background noise sources mapped, and the number of their occurrences as a function of the sampling intervals used, are given in Table 3. A summation of the data obtained from the six sampling points is graphically presented in Figure 9.

Selection of Primary Test Sites

37. A comparison of the data presented in Figure 9 with that given in Figure 5 (Mafraq area) brings out the following facts:

a. Most of the background noise sources mapped in the Mafraq area are found in this area.

b. A considerable amount of water wells was mapped in the Mafraq area. These are mostly shallow, hand-dug wells with low yields. Most water wells in the Ozona area are deep wells (120-150 m) with significant sustained yields.

c. Most U. S. topographic maps do not identify the various agricultural areas. Ozona is the center of a major agricultural region, mostly ranching and related activities; however, no agricultural areas were mapped in this area because they could not be identified.

d. There were no railroads mapped in this area. This is not considered to be a serious impediment to the field data collection program. The AT&SF line crosses the Edwards Plateau at Barnhart, a town about 45 km north of Ozona.

e. Military installations and facilities (e.g., barracks and training areas) are located in or near the town of Mafraq, a major military post in eastern Jordan. There are no major military installations in the Ozona area; however, some of the military installations in Texas are in regionally similar terrain (e.g. Fort Hood) and could be used to obtain background noise signatures in a military environment.

f. Ozona is an important gas and oil producing area. There are no oil or gas wells in the Mafraq area, which is a major monitoring and maintenance center for the Iranian Petroleum Company pipeline.

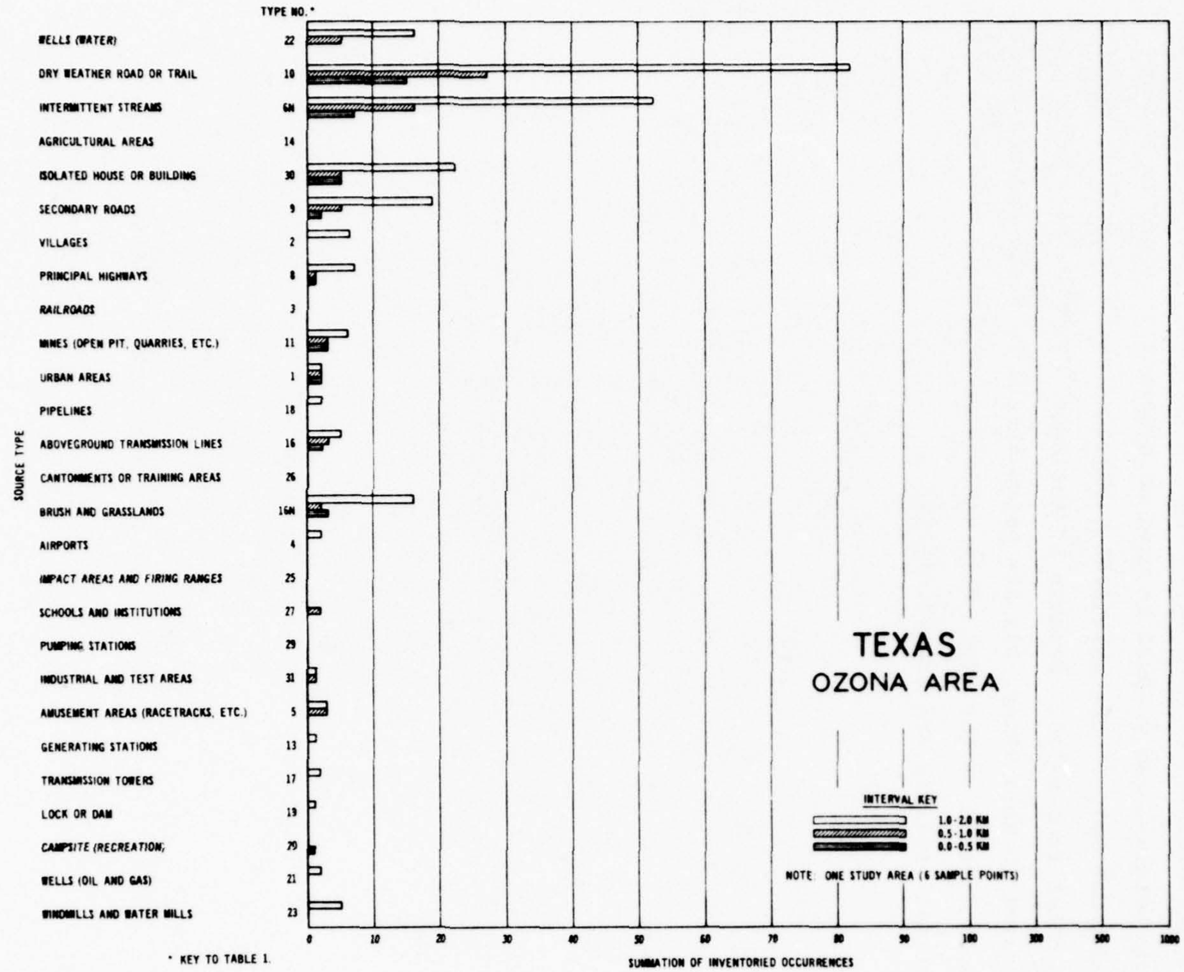


Figure 9. Noise source occurrences corresponding to those of Jordan (Figure 5)

38. Six sampling points were used to map the types and number of occurrences of background noise sources found in the Ozona area. On the basis of the information presented in Table 3, sampling points 2, 3, 4, and 5 are designated primary sites for the field data collection program. Sampling points 1 and 6 could be used as alternative sites to sample most, but not all, of the potential background noise sources identified in the other four sites. Because of the date (1967) of the Ozona quadrangle used in this study, all six sites should be field-checked prior to the initiation of the field data collection effort to determine their present availability and accessibility.

PART VI: CONCLUSIONS

West Germany and Atlantic Coastal Plain Sites

39. It is concluded that an acceptable degree of similarity has been established between the regional physiographic characteristics of the North German Plain (West Germany) and those of the Atlantic Coastal Plain of Maryland and Virginia. On the basis of the cultural background noise sources identified in West Germany and in the Atlantic Coastal Plain, and of the background signatures inferred from these sources, it is felt that an acceptable level of similarity has been established between these two geographic regions.

40. The four sampling points selected in the Laurel quadrangle are designated primary sites for the field data collection program. Those sites selected in the Savage and Occoquan quadrangles were chosen mainly for the acquisition of cultural (acoustic) background noise signature data and could be used as possible alternative sites in the data collection effort.

Jordan and Edwards Plateau Sites

41. A good correlation was established between the regional physiographic characteristics of the Mafraq area of eastern Jordan and those of the Ozona area of southwest Texas. The cultural differences between eastern Jordan and southwest Texas are significant; nevertheless, it is expected that most of the background noise signatures of the two areas can be successfully correlated, so the selection of the Ozona area is considered an acceptable compromise.

42. Sampling points 2, 3, 4, and 5 in the Ozona area are designated primary sites for the field data collection program. Sampling points 1 and 6 could be used as alternative sites to sample most, but not all, of the potential background noise sources identified in the other four sites.

Recommendations

43. All selected sampling sites in the Atlantic Coastal Plain should be field-checked to determine their availability prior to the initiation of the field data collection program. Final site selection for the collection of field signature data should be made in locations with a deep soil or sediment cover, preferably greater than 6 m, to avoid possible complications from exposed or shallow bedrock. Likewise, all the selected sites in the Edwards Plateau should be field-checked to determine their availability and accessibility prior to the initiation of the field data collection effort.

44. Since most of the Mafraq study area is in the Eastern Plain of Jordan and in a predominantly rural and agricultural environment, it is recommended that a map study be made in a more urban area, preferably in the Western Hills and Mountains physiographic unit of Jordan (e.g. the Jerusalem area), to determine the possible mixes of background noise signatures present in this type of environment.

45. As soon as possible, the map-derived data should be field-validated by a ground truth data collection program in all the countries of interest, i.e. West Germany, Jordan, and the United States. Should access to Jordan not be feasible, the use of other compatible areas, such as Isreal, Saudi Arabia, and Latin America (Mexico, Peru, Colombia), should be considered.

46. There is a dire need for recent aerial photographs or maps in all areas of interest, i.e. West Germany, the Middle East, and the United States. Future studies in these areas should be preceded by the acquisition of good-quality mapping photography.

Table 1*

Cultural and Natural Background Noise Sources

Cultural		Natural	
1.	Urban areas	1N.	Rain
2.	Villages	2N.	Sleet
3.	Railroads	3N.	Hail
4.	Airports	4N.	Ice (glaciers, etc.)
5.	Amusement areas (race tracks, etc.)	5N.	Wind
6.	Waterways (canals, etc.)	6N.	Intermittent streams
7.	Interstate highways	7N.	Streams and rivers
8.	Principal highways	8N.	Shorelines (coast and lakes)
9.	Secondary roads	9N.	Waterfalls
10.	Dry weather roads or trails	10N.	Thunder
11.	Mines (underground and open pit)	11N.	Volcanoes and earth tremors
12.	Factories and mills	12N.	Rock cracking
13.	Generating stations	13N.	Animal noise
14.	Agricultural areas	14N.	Storms (sand)
15.	Construction operations	15N.	Forests or woodlands
16.	Aboveground transmission lines	16N.	Brush and grasslands
17.	Transmission towers (microwave)		
18.	Pipelines		
19.	Locks or dams		
20.	Campsites (recreation)		
21.	Wells (oil and gas)		
22.	Wells (water)		
23.	Windmills and water mills		
24.	Drawbridges and tunnels		
25.	Impact areas and firing ranges		
26.	Cantonments or training areas		
27.	Schools and institutions		
28.	Logging activities		
29.	Pumping stations		
30.	Isolated houses or buildings		
31.	Industrial and test areas		
32.	Tramways and aerial cableways		

* Revised from Table 25, WES Miscellaneous Paper M-75-10, paragraph 4.

Table 2

Universal Transverse Mercator (UTM) 1000-m Grid

Coordinates of Sampling Points

Sampling Point No.	UTM Grid Coordinates X	Y
West Germany Bad Oldesloe; L2128; 1:50,000*		
1	0667	6502
2	0716	6956
3	0718	7405
4	0465	8274
5	0158	7754
6	9983	7264
7	9695	6535
8	9209	6425
9	9233	7421
10	9308	8034
West Germany Wietze; L3324; 1:50,000*		
1	6400	3160
2	6282	3680
3	6451	4181
4	6363	4892
5	5664	4808
6	5297	4266
7	5498	3488
8	5325	3195
9	4826	3512
10	4754	4800

(Continued)

* Map name; sheet number; and scale, respectively.

(Sheet 1 of 3)

Table 2 (Continued)

Sampling Point No.	UTM Grid Coordinates X	UTM Grid Coordinates Y
West Germany		
Duren; L5104; 1:50,000*		
1	3240	4921
2	2430	4231
3	2450	3320
4	1943	3642
5	1494	3506
6	1584	4307
Jordan		
Mafraq; 3254 IV; 1:50,000*		
1	3880	7417
2	3779	7835
3	3755	8135
4	3929	8374
5	3897	8785
6	3888	9592
7	3657	9695
8	3569	9247
9	3203	8855
10	3210	8384
11	3260	7598
12	2615	7605
13	2503	8067
14	2520	9195
15	2243	9653
16	2204	8744

(Continued)

* Map name; sheet number; and scale, respectively.

Table 2 (Concluded)

Sampling Point No.	UTM Grid Coordinates X	UTM Grid Coordinates Y
Maryland		
Savage; 7.5' Quadrangle; 1:24,000 *		
1	4595	3658
2	4700	4334
3	4123	3505
Maryland		
Laurel; 7.5' Quadrangle; 1:24,000*		
1	4544	2006
2	4519	2607
3	4324	3000
4	4039	2809
Virginia		
Occoquan; 7.5' Quadrangle; 1:24,000*		
1	9950	7969
2	0199	8326
3	9545	8466
Texas		
Ozona; 7.5' Quadrangle; 1:24,000 *		
1	9283	9170
2	9458	9892
3	9128	0175
4	8805	0075
5	8921	9790
6	8699	9314

* Map name; sheet number, and scale, respectively.

(Sheet 3 of 3)

Table 3

Sampling Points, UTM Grid Coordinates, Background Noise Source Types,* Number of Occurrences, and Sampling Intervals

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		West Germany					
		Bad Oldesloe; 1:50,000; L2128; M745; 2**					
1	06676502	9	2	9	3	1	1
		10	3	10	6	2	7
		6	1	6	1	6	1
		2	1	2	3	8	3
		30	1	12	1	9	6
		7N	3	30	3	10	20
		14	3	14	5	3	1
				7N	6	30	8
						16	4
						14	26
						7N	10
						5	1
2	07166956	7	1	2	2	1	3
		9	2	1	1	2	7
		10	4	7	1	7	1
		14	3	8	1	8	4
				9	11	9	16
				10	17	10	29
				3	1	3	2
				30	8	30	17
				5	1	5	2
				14	9	14	21
				15N	1	15N	2
				7N	5	7N	17
						16	2
3	07187405	2	1	1	1	1	1
		30	3	30	16	2	4
		16	2	8	1	8	2
		9	2	9	3	9	11
		10	2	10	8	10	23
		14	2	14	11	3	1
				16	2	30	19
				3	1	16	2
				7N	6	14	14
						5	1
						15N	1
						7N	10

(Continued)

* Keyed to Table 1.
** Map name, scale, sheet number, series, and edition, respectively.

(Sheet 1 of 17)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	0-0.5 km No.	0.5-1.0 km Type	0.5-1.0 km No.	1.0-2.0 km Type	1.0-2.0 km No.
		West Germany (Continued)					
4	04658274	2	1	10	8	9	8
		30	8	8	1	10	32
		8	1	9	2	8	2
		9	4	2	1	2	5
		10	2	30	14	30	10
		14	4	14	5	15N	7
		7N	2	15N	3	14	6
				7N	4	7N	6
5	01587754	9	1	10	8	2	5
		10	5	9	2	8	1
		14	2	8	1	9	11
				3	1	10	22
				2	1	3	1
				30	1	14	9
				14	7	30	7
				15N	3	27	1
				7N	2	7N	10
						15N	4
6	99837264	9	1	8	1	8	1
		10	7	9	3	9	5
		14	3	10	10	10	29
		23	1	2	1	2	2
		8N	2	30	7	30	22
		30	4	14	5	16	1
		7N	2	8N	2	14	15
				15N	2	7N	20
				7N	9	5	1
7	96956535	1	1	1	1	1	1
		2	1	2	1	2	4
		8	2	8	3	3	1
		9	1	7	1	7	1
		10	2	9	5	8	4
		3	1	10	4	9	10
		8N	1	30	4	10	22
		7N	3	14	8	30	26
		14	2	8N	3	14	13
				7N	7	8N	1
				3	1	7N	15
						15N	1

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		West Germany (Continued)					
8	92096425	10	4	10	10	3	2
		3	1	8	1	1	1
		8	1	9	3	2	3
		14	3	3	2	30	32
		30	2	1	1	8	7
		7N	1	2	2	9	10
				30	7	10	25
				14	8	14	15
				7N	15	7N	31
						8N	1
						15N	2
9	92337421	9	1	9	2	2	4
		10	1	10	7	30	8
		14	3	14	7	3	1
				7N	6	8	2
						9	17
						10	24
						14	15
						7N	12
10	93088034	9	2	9	2	2	3
		14	2	10	4	30	7
		15N	1	14	5	16	1
		7N	1	15N	2	8N	1
				7N	7	14	16
				30	4	9	7
						10	13
						7N	25
		West Germany Wietze; 1:50,000; L3324; M745; 1**					
1	64003160	10	7	8	1	10	50
		9	2	9	11	9	12
		14	3	10	13	8	2
		2	2	2	2	2	3
		15N	1	30	13	30	3
				16N	2	14	7
				15N	1	16N	6
				14	5	15N	1
						5	4
						16	1
						27	1
						12	1
						7N	7

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		West Germany (Continued)					
2	62823680	8	1	10	13	10	46
		9	2	8	1	9	5
		10	7	2	1	8	7
		2	1	30	6	3	1
		14	3	14	8	2	4
		15N	3	16N	4	30	15
		16N	2	15N	4	14	7
		7N	1	5	1	15N	5
				7N	2	16N	1
						7N	4
3	64514181	10	8	10	16	10	41
		15N	1	15N	1	8	3
						9	2
						2	1
						30	7
						14	8
						15N	6
						16N	4
						7N	9
4	63634892	1	1	1	1	8	3
		8	1	8	1	9	7
		9	1	9	1	10	38
		10	6	10	14	1	1
		14	2	14	1	2	2
		15N	1	15N	4	30	4
		7N	1	16N	2	14	9
				7N	3	3	2
				30	1	16N	8
				5	1	15N	11
						7N	5
						5	4
5	56644808	9	1	9	4	9	3
		10	8	10	18	10	53
		16N	1	30	1	16N	3
				16N	1	15N	8
				14	2	14	[illegible]
				15N	2	30	4
						7N	10

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		West Germany (Continued)					
6	52974266	10	5	10	9	10	21
		7N	4	7N	14	9	3
		16N	1	16N	2	14	14
				14	4	16N	16
						15N	3
						31	1
						2	1
						30	4
						7N	46
						8N	18
7	54983488	9	5	7N	3	10	55
		8	1	8N	3	9	6
		10	4	10	17	8	1
		3	1	9	5	3	1
		31	1	8	1	32	1
		11	1	3	1	2	2
		30	3	32	2	30	4
		14	2	31	2	14	5
		15N	2	2	1	15N	6
		7N	1	30	5	16N	7
		8N	1	15N	3	7N	6
		32	2	16N	3	5	1
				14	2	16	1
8	53253195	10	9	10	25	10	57
		15N	1	15N	1	15N	2
				30	3	30	2
				14	1	16N	3
						8N	2
						7N	5
9	48263512	3	1	2	1	7N	26
		9	2	8	1	2	2
		10	5	9	2	10	27
		14	2	10	9	8	1
		15N	4	14	4	9	4
		16N	1	15N	6	7	[illegible]
		7N	1	16N	1	15N	8
				7N	10	16N	6
				7	1	14	11
						3	1
						30	2

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		West Germany (Continued)					
10	47544800	10	10	10	27	8	4
		9	1	9	1	9	12
		15N	4	8	2	10	65
		30	2	2	3	2	4
		2	1	30	2	30	7
				14	4	14	12
				15N	6	15N	13
				16N	3	16N	9
				17	1	5	1
						7N	4
		West Germany Duren; 1:50,000; L5104; M745; 2**					
1	32404921	11	1	11	1	11	1
		9	4	9	4	9	12
		10	2	8	1	8	2
		16	1	10	9	10	28
		14	8	16	2	1	1
		15N	2	30	7	2	3
		7N	5	2	1	16	2
		2	1	14	7	14	12
		30	1	15N	5	15N	3
		8N	2	7N	3	3	1
				3	1	30	6
						7N	4
						31	1
						5	1
2	24304231	15N	1	15N	1	15N	4
		9	1	9	2	16	1
		10	9	10	21	8	1
						9	2
						10	50
						7N	1
						30	3
						14	3

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	0-0.5 km Type	0-0.5 km No.	0.5-1.0 km Type	0.5-1.0 km No.	1.0-2.0 km Type	1.0-2.0 km No.
		West Germany (Continued)					
3	24503320	9	2	3	4	10	40
		10	3	10	20	9	18
		3	3	9	5	8	3
				16	1	7N	1
				2	2	14	6
				30	15	30	11
				14	4	2	2
						1	1
						3	3
						16	1
						5	2
						31	2
						15N	1
4	19433642	7N	2	7N	8	8	6
		16N	1	15N	2	7	1
		15N	1	31	1	9	6
		9	2	8	4	10	71
		10	4	9	5	7N	12
		2	2	10	14	2	5
		5	1	14	7	30	10
		30	1	16N	2	16	1
				2	2	14	10
				30	3	15N	4
				5	1	16N	2
						3	1
						23	1
						5	1
						19	1

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals: 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		West Germany (Continued)					
5	14943506	9	3	8N	1	9	12
		7	1	7N	1	10	47
		16	2	15N	1	7	1
		2	1	7	1	2	5
		10	8	9	3	30	14
		14	4	10	18	16	3
		7N	4	2	2	8N	1
		15N	1	30	2	7N	6
		30	1	14	7	3	1
				5	1	15N	4
				16	2	14	9
						29	1
						31	1
						16N	1
						5	1
						32	1
6	15844307	8	2	8	2	1	1
		9	3	9	2	31	3
		10	4	10	14	2	4
		3	1	3	3	8	5
		14	5	31	2	9	7
		15N	1	14	5	10	27
		7N	2	15N	1	3	4
		31	1	7N	3	30	19
				30	9	14	17
						15N	4
						7N	8
						8N	6
						5	1
						16N	2
						16	1
		Jordan Mafraq; 1:50,000; 3254 IV; K737; 2**					
1	38807417	10	5	10	6	10	13
		22	10	22	8	22	6
		2	1	30	3	30	1
		6N	1	27	1	[illegible]	[illegible]
		14	1	3	1	6N	16
				6N	6	14	3
				14	2		

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Jordan (Continued)					
2	37797835	10	4	10	5	10	13
		14	1	30	2	8	1
		6N	2	3	1	16	1
				14	1	30	5
				6N	5	14	3
				16	1	3	1
						6N	18
3	37558135	1	1	1	1	1	2
		8	2	26	1	26	1
		16	1	8	2	30	5
		10	5	9	2	22	1
		30	3	10	13	3	1
		14	1	30	2	8	4
				16	1	9	9
				14	1	10	32
				6N	1	16	1
						14	3
						6N	12
4	39298374	10	6	10	14	3	1
		14	1	8	3	10	26
		6N	1	9	2	9	10
				26	1	8	5
				1	2	1	4
				14	2	26	3
				6N	3	4	1
						31	1
						14	2
						6N	6
5	38978785	10	6	10	14	10	21
		14	1	14	2	3	1
				6N	4	25	1
						30	2
						11	4
						14	7
						6N	13
						8	1

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Jordan (Continued)					
6	38889592	10	8	10	10	10	23
		22	2	22	15	22	54
		14	1	2	1	16	1
				3	1	3	1
				14	2	30	2
				6N	2	2	3
						14	4
						18	1
						6N	12
7	36579695	10	2	10	9	10	24
		22	1	22	6	3	1
		30	1	18	1	18	2
		14	1	11	1	16	1
		6N	3	30	2	29	1
				14	2	22	41
				6N	10	30	2
				2	1	2	3
						14	5
						6N	18
8	35699247	10	1	10	4	10	14
		22	4	30	1	30	1
		30	1	22	2	22	12
		14	2	14	3	14	5
		6N	5	6N	6	6N	15
9	32038855	10	7	10	10	8	1
		22	14	22	11	10	24
		30	6	30	5	11	1
		2	1	16N	1	22	5
		14	1	6N	7	18	1
		16N	1	14	3	14	6
		6N	2			16N	1
						6N	19
10	32108384	10	6	10	17	10	40
		14	1	22	12	22	[illegible]
		6N	2	30	8	30	10
				14	3	2	4
				6N	4	11	2
						14	5
						6N	18

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Jordan (Continued)					
11	32607598	10	4	10	8	10	18
		14	2	30	2	30	3
		6N	3	22	4	22	17
				14	7	14	11
				6N	7	6N	22
12	26157605	10	7	10	10	10	24
		14	2	22	11	22	38
		6N	4	30	5	30	13
				14	3	14	7
				6N	6	6N	16
13	25038067	10	1	10	3	10	21
		9	1	9	1	9	2
		22	4	2	1	8	1
		14	1	22	21	22	68
		6N	1	30	2	2	2
				14	1	30	7
				6N	1	14	3
						6N	4
14	25209195	10	5	10	9	8	1
		22	7	22	20	9	1
		2	1	2	1	10	17
		14	1	14	3	30	1
		6N	1	6N	5	22	12
						18	1
						14	3
						6N	26
15	22439653	10	3	10	5	8	1
		14	1	8	1	10	18
		6N	2	30	4	22	17
				14	1	2	1
				6N	4	30	5
				2	1	14	3
				22	1	6N	27

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Jordan (Continued)					
16	22048744	10	4	2	1	10	20
		30	1	10	8	2	2
		14	3	22	6	22	21
		6N	1	14	4	30	4
				6N	7	14	11
						6N	20
		Maryland					
		Savage; .:24,000; Savage Quad; 7.5 Minutes; Photorevised 1974**					
1	45953658	8	1	8	2	7	1
		9	5	9	20	8	3
		30	5	10	7	9	31
		27	1	2	4	10	17
		6N	1	30	34	3	4
		15N	1	17	1	2	6
				6N	3	30	73
				7N	2	27	1
				15N	13	14	1
						6N	6
						7N	17
						15N	26
2	47004334	9	2	9	13	9	36
		10	3	10	9	10	22
		16	1	30	52	16	4
		30	7	2	2	8	1
		14	3	16	4	2	7
		7N	2	14	3	30	89
		15N	3	27	1	14	5
				13	1	6N	5
				17	1	7N	9
				7N	4	15N	14
				15N	8	8N	1
				8N	1	19	1

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals: 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Maryland (Continued)					
3	41233505	7	1	7	1	2	3
		9	1	9	5	1	1
		10	6	10	4	9	25
		30	25	2	1	10	27
		7N	1	30	25	7	1
		15N	3	14	2	30	111
				6N	2	27	1
				7N	2	19	4
				15N	6	8N	5
						6N	3
						7N	12
						15N	24
						14	1
		Maryland Laurel; 1:24,000; Laurel Quad; 7.5 Minutes; Photorevised 1971**					
1	45442006	9	4	9	12	8N	9
		10	1	16	3	19	5
		30	19	30	14	9	28
		16	3	6N	3	10	27
		11	1	1	1	30	55
		6N	2	11	4	1	1
		15N	5	15N	3	2	3
						16	6
						13	1
						17	1
						11	5
						3	2
						15N	11
						6N	11
						7N	8
						20	1
2	45192607	15N	1	15N	1	7N	8
		6N	1	9	8	6N	10
		9	3	10	5	9	16
		10	1	6N	6	10	16
				30	2	15N	4
				3N	1	[illegible]	[illegible]
						30	6
						11	2

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Maryland (Continued)					
3	43243000	10	2	7N	1	3	2
		9	3	6N	2	9	25
		2	1	10	5	10	19
		30	2	9	7	7	1
		5	1	8	1	8	2
		15N	1	1	1	1	1
				2	1	2	6
				30	16	30	52
				11	2	16	1
				5	1	7N	9
				15N	3	6N	4
						31	2
						27	1
						11	1
						5	2
						14	1
						15N	25
4	40392809	1	1	1	2	1	5
		2	2	2	2	2	5
		8	2	30	10	8	4
		9	2	31	3	9	19
		10	2	8	4	10	10
		3	1	9	9	5	2
		30	6	10	6	30	32
		20	1	3	2	31	6
		7N	1	6N	1	4	1
		8N	3	7N	7	3	1
		15N	10	8N	2	27	2
				15N	11	8N	5
				14	1	7N	14
						6N	3
						11	1
						15N	29

(Continued)

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals: 0-0.5 km Type	0-0.5 km No.	0.5-1.0 km Type	0.5-1.0 km No.	1.0-2.0 km Type	1.0-2.0 km No.
		Virginia					
Occoquan; 1:24,000; Occoquan Quad; 7.5 Minutes; Photorevised 1971**							
1	99507969	9	4	6N	5	9	12
		10	2	7N	1	10	23
		16	2	9	2	16	6
		1	1	10	3	8N	7
		30	9	16	3	19	6
		6N	3	30	18	1	3
		15N	3	1	1	2	8
				2	1	30	108
				15N	2	17	1
						27	1
						7	1
						6N	18
						7N	4
						15N	13
2	01998326	2	3	10	6	7N	7
		9	8	9	11	6N	18
		10	1	2	6	19	2
		6N	2	30	17	8N	5
		30	7	8N	1	16	7
		15N	1	19	1	7	1
				16	4	9	25
				6N	8	10	11
				15N	2	1	2
						2	5
						30	20
						31	4
						11	2
						29	2
						3	1
						27	1
						15N	19
3	95458466	9	3	7N	2	6N	13
		10	1	6N	5	7N	4
		6N	2	9	3	10	9
		7N	1	10	7	2	3
		30	11	30	11	30	37
		15N	1	15N	1	9	8
						15N	2

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Continued)

Sampling Point No.	1000-m Coordinates	Sampling Intervals: 0-0.5 km Type	0-0.5 km No.	0.5-1.0 km Type	0.5-1.0 km No.	1.0-2.0 km Type	1.0-2.0 km No.
		Texas Ozona; 1:24,000; Ozona Quad; 7.5 Minutes; 1967					
1	92839170	10	1	10	3	10	4
		6N	1	6N	3	6N	12
				16N	1	16N	6
						9	1
						23	1
2	94589892	16	1	10	3	10	8
		8	1	11	2	16N	3
		20	1	16	1	6N	7
		10	2	8	1	9	1
		11	1	6N	2	16	1
		6N	1			8	1
						23	1
						19	1
3	91280175	10	3	6N	2	6N	7
				10	5	10	13
						30	3
						23	1
						16	1
						8	2
						9	1
						5	1
						4	1
						16N	1
						11	2
						21	1
						22	2
4	88050075	10	4	16	2	11	2
		1	1	6N	2	10	19
		16	1	10	6	6N	7
				9	2	16N	3
				1	1	4	1
				30	4	31	1
				27	1	30	5
				5	1	9	5
				22	2	8	2
						5	1
						13	1
						17	1
						1	1
						2	3
						22	3
						16	3

(Continued)

** Map name, scale, sheet number, series, and edition, respectively.

Table 3 (Concluded)

Sampling Point No.	1000-m Coordinates	Sampling Intervals 0-0.5 km Type	No.	0.5-1.0 km Type	No.	1.0-2.0 km Type	No.
		Texas (Continued)					
5	89219790	1	1	1	1	1	1
		30	5	30	1	2	4
		9	2	5	2	30	10
		10	3	27	1	8	2
		6N	3	10	5	9	10
		11	1	9	3	10	18
		16N	1	6N	5	22	10
				11	1	17	1
				31	1	5	1
				22	3	6N	10
						11	1
						18	1
6	86999314	6N	2	6N	2	6N	9
		16N	2	16N	1	10	20
		10	2	10	5	18	1
		11	1			9	1
						11	1
						23	2
						21	1
						22	1
						30	4
						16N	3

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Zappi, Marcos A

Status report for selection of sites for background noise signature data base development / by Marcos A. Zappi. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.

34, [21] p. : ill. ; 27 cm. (Miscellaneous paper - U. S. Army Engineer Waterways Experiment Station ; M-78-1)

Prepared for Project Manager, Remotely Monitored Battlefield Surveillance System, U. S. Army Materiel Development and Readiness Command, Fort Monmouth, New Jersey.

1. Remotely monitored battlefield sensor system. 2. Seismic waves. 3. Sensors. 4. Site selection. 5. Sound waves. 6. Target classification. 7. Vehicle (Signature). I. United States. Army Materiel Development and Readiness Command. II. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Miscellaneous paper ; M-78-1.

TA7.W34m no.M-78-1

78